

There's no place like dome

By *Kristan Hutchison*
Sun staff

What the National Science Foundation needed in 1970 was the biggest umbrella in the world to shield new buildings at Amundsen-Scott South Pole Station from blowing snow.



(Click to enlarge and view caption)

That's exactly what they got, a 65-foot-tall aluminum dome reflecting back sun or moonlight, depending on the season. The first, and in many ways only, structure of its kind, the South Pole dome outlasted its designers initial estimates by 20 years.

The NSF had already decided to build a dome when it contacted Temcor. The California company was co-founded by Donald Richter, who learned geodesic dome design from the inventor himself, Buckminster Fuller.

A dome shape provided the best ratio of strength and size to weight, Richter said. Because it was built from panels, the pieces could all fit within an LC-130 and took only five flights to transport.

Each component weighed 50 pounds or less, making them easy to handle. Geodesic domes were also touted to be very fast and easy to put up, so it could be accomplished during the four-month summer.

Richter became the principal engineer on the new South Pole dome.

"It certainly was a challenging project for us, as it would be for anyone because of the conditions," Richter said. "It is a very special dome in some details that are specific to the Antarctic."

The dome was designed to stop the snow, but didn't need to be sealed against rain. The biggest difference between the South Pole dome and other domes was that instead of a foundation it sits on a pad of timbers on snow and ice. Changes in the ice below gave it an unreliable foundation and became the dome's downfall.

The South Pole dome was one of the first to use a multi-frame system, which has since been used in thousands of domes around the world, Richter said.

"It was one of the first of that kind," Richter said. "That was kind of a pioneer dome."

The South Pole dome was also the first to be analyzed by a computer, said Gary Curtis, an independent consultant hired by Temcor to work on the dome.

"The Navy wanted a full analysis done of the thing, so that's what we did," Curtis said.

"Computers were just barely able to handle stuff like that."

Other features were changed after the South Pole dome, including smoothing out the exterior, said George Donaldson, another Temcor engineer.

"If you would slide down the dome at the South Pole you'd probably rip up your clothing," Donaldson said.

Polar construction is never easy. Normally, geodesic domes are built from the top down, hanging from a central tower. The South Pole required a different technique because the LC-130s couldn't carry a tall enough tower, Mattis said. Instead, the top three-fourths of the dome was built down from a 65-foot tower and the bottom section was built up from the ground. Then the two parts were joined in the middle.

The dome was supposed to be done in one season, Mattis said. He arrived in December of 1971 to oversee preparation of the foundation, but the hydraulic equipment needed for the foundation and bolting together the dome froze up in the cold. The problems were ironed out in the off-season and Mattis returned in 1972. By mid-January the dome was done.

Bill Spindler was the winter-over manager in 1977, when the dome was just a few years old.

"The station was bright new and shiny and clean and the dome wasn't settling and there weren't any cracks," Spindler said.

Or was it? On closer inspection, snow was already drifting onto the downwind side of the dome, pushing down the platform of snow and timber beneath it.

"We actually first noticed what turned out to be the settlement in the winter 1977. There were some hairline cracks in the floor," Spindler said. "The floor of the utilidor tunnel did start to tilt downward."

By 1982 the tilt was severe enough that Temcor sent Curtis down to look at it. He found a big crack under the dome, which had settled two feet. The dome had tilted and deflected, but was still intact. Curtis recommended that snow be removed, but nothing was done at that time.

The snow kept piling up. In 1989 someone heard a loud bang in the dome and Curtis was called down again. He found the tension ring holding the dome together had snapped in two places under the strain of the foundation sagging and twisting.



(Click to enlarge and view caption)

"Normally that would be a disaster for a dome, but this time it wasn't a problem because it was trapped in all the ice that was around it," Curtis said.

The tension ring couldn't be fixed until the next summer, so Spindler had to stand up and explain to the winter-overs that the dome was safe for the winter.

Curtis came down again in 1990 with newly manufactured parts and 10 hand-operated jacks. Five of the jacks broke by the end as they lifted and evened out the dome.

"We completely rebuilt it until it was as good as new," Curtis said. "The dome was good for another 20 years."

But the NSF was already planning a new station. Snow continues to pile up against the downwind side of the dome, pushing down the foundation, so the dome is again skewed a foot, said NSF Facilities Engineer Projects Manager Frank Brier. Though early plans included the dome, the foundation problems led the NSF to drop the dome completely. Despite the problems, the silver dome has exceeded expectations, outliving its projected life several times over and becoming a symbol of the South Pole.

"Obviously it still impresses people," Spindler said. "Because when people think of the South Pole station they think of the striped pole in front of the dome."

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